Claims

1. Valve, for e.g. a pilot valve in an IP regulator, realised for example in a MEMS-structure, comprising a fluid inlet (3) and a fluid outlet (4) coupled by a fluid channel (2), all of which being defined by walls and structures (5) produced by micromachining of glass and or silicon, and an actuator (1,8,9) which can be set to at least at two different positions in order to vary the flow cross section of the fluid channel (2),
c h a r a c t e r i z e d i n that the geometries of the fluid inlet, outlet and channel are adapted for preventing the flow from changing its direction so sharply that a significant portion of contaminating droplets and or particles in the flow hit the walls of structures, as given in any arrangement according to or between the following two extremes:

i) flow outlet is perpendicular to the flow inlet and the outlet dimension is larger than a critical dimension, L_{crit} estimated according to:

$$L_{crit} = \frac{V_1 \cdot \rho_f \cdot m}{3 \cdot \pi \cdot \mu_f \cdot \Delta\rho \cdot d}$$

where V_1 is the mean flow velocity at the output of the input flow channel (3), ρ_f is the density of the fluid, m is the mass of the particles or droplets, μ_f is the viscosity of the fluid, $\Delta\rho$ is the difference in the density of the particle or droplet material and the fluid material, d is the typical diameter of the particles or droplets, and m is the mass of the particles, or as simulated in a CFD-tool (Computational Fluid Dynamics),

i) flow outlet and flow channel is generally parallel to flow inlet giving a substantially unidirectional flow pattern.

2. Valve according to claim 1,
comprising a non-rigid membrane (1) arranged in the fluid channel (2).

3. Valve according to claim 2,
comprising an electrostatic actuator (1,8,9) with a first electrode (8) on the side of the membrane facing the fluid channel and a second electrode (9) on the inside of the channel (2) opposite to the membrane (1), whereby changing the voltage on the actuator (1,8,9) will change the channel cross section.

4. Valve according to one of the claims 1-3
comprising an electrostatic actuator (1,8,9) with a first electrode (8) on the side of the membrane facing away from the fluid channel and a second electrode (9) on a (normally) flat surface facing the first electrode, forming a cavity (14) between the electrodes (8,9) over which the electric field of the actuator (1,8,9) is acting, thus avoiding a field across the fluid channel (2) that may otherwise direct particles in the flow towards the walls of the channel.

5. Valve according to claim 3 or 4,
wherein AC voltages are applied to the actuator (1,8,9) to set up vibrations of suitable frequency in the membrane (1) whereby the vibrations cause particles or layers attached to the membrane (1) to loosen and be flushed out of the device by the fluid flow.

6. Valve according to any one of the preceding claims,
comprising pneumatic feedback means (12,13) for reducing the pressure difference between each side of the membrane (1).

7. Valve according to claim 6,
where the pneumatic feedback means (12,13) comprises a fluid connection (13) between the fluid channel (2) and a cavity (14) on one side of the membrane (1).

8. Valve according to any of the preceding claims, wherein all sharp corners of the fluid channels (2), specifically those at the entrance of the fluid channel (2) under a boss of the valve, are rounded to avoid large flow gradients and corresponding contamination problems on the walls just after any corners, e.g. by suitable etching procedures during the MEMS fabrication.

9. Valve according to any of the preceding claims, comprising a thin (nanotechnological) layer on all fluid channel walls of the device to achieve hydrofobic and oleofobic surfaces to repel water and oil based particles, droplets or even vapour in the case of condensation can take place.